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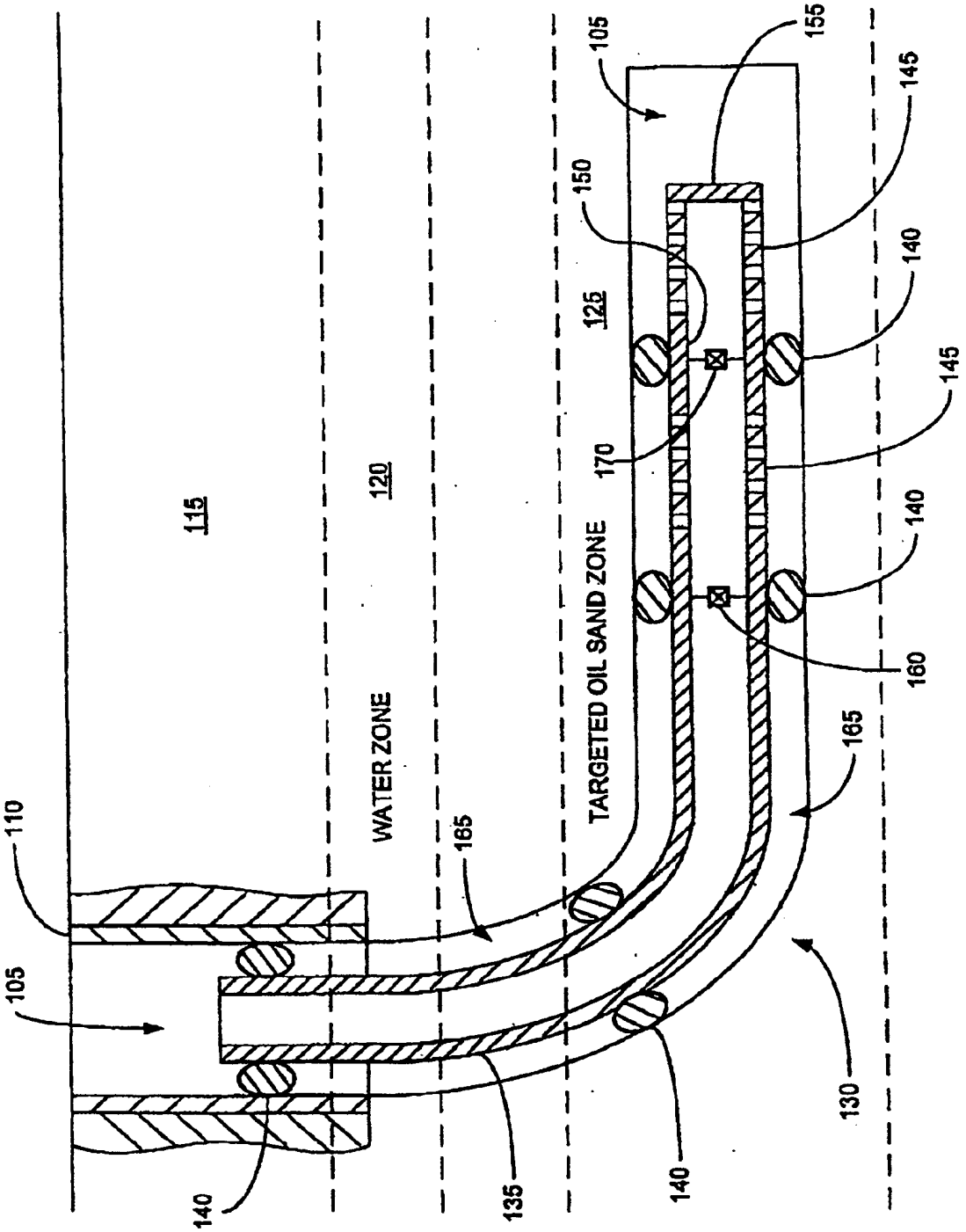

FIGURE 1

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ISOLATION OF SUBTERRANEAN ZONES

BACKGROUND OF THE INVENTION

This invention relates generally to oil and gas exploration, and in particular to isolating certain subterranean zones to facilitate oil and gas exploration.

During oil exploration, a wellbore typically traverses a number of zones within a subterranean formation. Some of these subterranean zones will produce oil and gas, while others will not. Further, it is often necessary to isolate subterranean zones from one another in order to facilitate the exploration for and production of oil and gas. Existing methods for isolating subterranean production zones in order to facilitate the exploration for and production of oil and gas are complex and expensive.

The present invention is directed to overcoming one or more of the limitations of the existing processes for isolating subterranean zones during oil and gas exploration.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, there is provided a system for extracting fluidic materials from one or more subterranean formations traversed by a wellbore, comprising one or more solid tubular members positioned within the wellbore, one or more of the solid tubular members including one or more external seals; one or more slotted tubular members positioned within the wellbore coupled to each of the solid tubular members for extracting fluidic materials from one or more of the subterranean formations; and a

shoe positioned within the wellbore coupled to one of the slotted tubular members, wherein one or more of the solid tubular members are radially expanded into intimate contact with the wellbore.

According to another aspect of the present invention, there is provided a method of isolating a first subterranean zone from a second subterranean zone in a wellbore, comprising positioning one or more primary solid tubulars within the wellbore, each of the primary solid tubulars traversing the first subterranean zone; positioning one or more slotted tubulars within the wellbore, each of the slotted tubulars traversing the second subterranean zone; fluidicly coupling the slotted tubulars and the solid tubulars; and preventing the passage of fluids from the first subterranean zone to the second subterranean zone within the wellbore external to the solid and slotted tubulars by radially expanding at least one of the primary solid tubulars into intimate contact with the wellbore.

According to another aspect of the present invention, there is provided a method of extracting materials from a producing subterranean zone in a wellbore, at least a portion of the wellbore including a casing, comprising positioning one or more primary solid tubulars within the wellbore; fluidicly coupling the primary solid tubulars with the casing; positioning one or more slotted tubulars within the wellbore, the slotted tubulars traversing the producing subterranean zone; fluidicly coupling the slotted tubulars with the solid tubulars; fluidicly isolating the producing subterranean zone from at least one other subterranean zone within the wellbore by radially expanding at least

one of the solid tubulars into intimate contact with the wellbore; and fluidicly coupling at least one of the slotted tubulars with the producing subterranean zone.

According to another aspect of the present invention, there is provided apparatus comprising one or more solid tubular members positioned within a wellbore, each of the solid tubular members including one or more external seals; one or more slotted tubular members positioned within the wellbore coupled to the solid tubular members; and a shoe positioned within the wellbore coupled to one of the slotted tubular members; wherein at least one of the solid tubular members and the slotted tubular members are formed by a radial expansion process performed within the wellbore in which at least one of the solid tubular members and the slotted tubular members are radially expanded into intimate contact with the wellbore.

According to yet another aspect of the present invention, there is provided a system for extracting materials from a producing subterranean zone in a wellbore, at least a portion of the wellbore including a casing, comprising means for positioning one or more primary solid tubulars within the wellbore; means for fluidicly coupling the primary solid tubulars with the casing; means for positioning one or more slotted tubulars within the wellbore, the slotted tubulars traversing the producing subterranean zone; means for fluidicly coupling the slotted tubulars with the solid tubulars; means for fluidicly isolating the producing subterranean zone from at least one other subterranean zone within the wellbore; means for fluidicly coupling

at least one of the slotted tubulars with the producing subterranean zone; and means for radially expanding at least one of the solid tubulars and the slotted tubulars into intimate contact with the wellbore.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a fragmentary cross-sectional view illustrating the isolation of subterranean zones.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

An apparatus and method for isolating one or more subterranean zones from one or more other subterranean zones is provided. The apparatus and method permits a producing zone to be isolated from a nonproducing zone using a combination of solid and slotted tubulars. In the production mode, the teachings of the present disclosure may be used in combination with conventional, well known, production completion equipment and methods using a series of packers, solid tubing, perforating tubing, and sliding sleeves, which will be inserted into the disclosed apparatus to permit the commingling and/or isolation of the subterranean zones from each other.

Referring to Fig. 1, a wellbore 105 including a casing 110 are positioned in a subterranean formation 115. The subterranean formation 115 includes a number of productive and non-productive zones, including a water zone 120 and a targeted oil sand zone 125. During exploration of the subterranean formation 115, the wellbore 105 may be extended in a well known manner to traverse the various productive and non-productive zones, including the water zone 120 and the targeted oil sand zone 125.

In a preferred embodiment, in order to fluidicly isolate the water zone 120 from the targeted oil and sand zone 125, an apparatus 130 is provided that includes one or more sections of solid casing 135, one or more external seals 140, one or more sections of slotted casing 145, one or more intermediate sections of solid casing 150, and a solid shoe 155.

The solid casing 135 may provide a fluid conduit that transmits fluids and other materials from one end of the solid casing 135 to the other end of the solid casing 135. The solid casing 135 may comprise any number of conventional commercially available sections of solid tubular casing such as, for example, oilfield tubulars fabricated from chromium steel or fiberglass. In a preferred embodiment, the solid casing 135 comprises oilfield tubulars available from various foreign and domestic steel mills.

The solid casing 135 is preferably coupled to the casing 110. The solid casing 135 may be coupled to the casing 110 using any number of conventional commercially available processes such as, for example, welding, slotted and expandable connectors, or expandable solid connectors. In a preferred embodiment, the solid casing 135 is coupled to the casing 110 by using expandable solid connectors. The solid casing 135 may comprise a plurality of such solid casing 135.

The solid casing 135 is coupled to one more of the slotted casings 145. The solid casing 135 may be coupled to the slotted casing 145 using any number of conventional commercially available processes such as, for example, welding, or slotted and expandable connectors. In a preferred embodiment, the solid

casing 135 is coupled to the slotted casing 145 by expandable solid connectors.

In a preferred embodiment, the casing 135 includes one more valve members 160 for controlling the flow of fluids and other materials within the interior region of the casing 135. In an alternative embodiment, during the production mode of operation, an internal tubular string with various arrangements of packers, perforated tubing, sliding sleeves, and valves may be employed within the apparatus to provide various options for commingling and isolating subterranean zones from each other while providing a fluid path to the surface.

In a particularly preferred embodiment, the casing 135 is placed into the wellbore 105 by expanding the casing 135 in the radial direction into intimate contact with the interior walls of the wellbore 105. The casing 135 may be expanded in the radial direction using any number of conventional commercially available methods.

The seals 140 prevent the passage of fluids and other materials within the annular region 165 between the solid casings 135 and 150 and the wellbore 105. The seals 140 may comprise any number of conventional commercially available sealing materials suitable for sealing a casing in a wellbore such as, for example, lead, rubber or epoxy. In a preferred embodiment, the seals 140 comprise Stratalok epoxy material available from Halliburton Energy Services. The slotted casing 145 permits fluids and other materials to pass into and out of the interior of the slotted casing 145 from and to the annular region 165. In this manner, oil and gas may be produced from a producing subterranean zone

within a subterranean formation. The slotted casing 145 may comprise any number of conventional commercially available sections of slotted tubular casing. In a preferred embodiment, the slotted casing 145 comprises expandable slotted tubular casing available from Petroline in Aberdeen, Scotland. In a particularly preferred embodiment, the slotted casing 145 comprises expandable slotted sandscreen tubular casing available from Petroline in Aberdeen, Scotland.

The slotted casing 145 is coupled to one or more solid casing 135. The slotted casing 145 may be coupled to the solid casing 135 using any number of conventional commercially available processes such as, for example, welding, or slotted or solid expandable connectors. In a preferred embodiment, the slotted casing 145 is coupled to the solid casing 135 by expandable solid connectors.

The slotted casing 145 is preferably coupled to one or more intermediate solid casings 150. The slotted casing 145 may be coupled to the intermediate solid

casing 150 using any number of conventional commercially available processes such as, for example, welding or expandable solid or slotted connectors. In a preferred embodiment, the slotted casing 145 is coupled to the intermediate solid casing 150 by expandable solid connectors.

The last slotted casing 145 is preferably coupled to the shoe 155. The last slotted casing 145 may be coupled to the shoe 155 using any number of conventional commercially available processes such as, for example, welding or expandable solid or slotted connectors. In a preferred embodiment, the last slotted casing 145 is coupled to the shoe 155 by an expandable solid connector.

In an alternative embodiment, the shoe 155 is coupled directly to the last one of the intermediate solid casings 150.

In a preferred embodiment, the slotted casings 145 are positioned within the wellbore 105 by expanding the slotted casings 145 in a radial direction into intimate contact with the interior walls of the wellbore 105. The slotted casings 145 may be expanded in a radial direction using any number of conventional commercially available processes.

The intermediate solid casing 150 permits fluids and other materials to pass between adjacent slotted casings 145. The intermediate solid casing 150 may comprise any number of conventional commercially available sections of solid tubular casing such as, for example, oilfield tubulars fabricated from chromium steel or fiberglass. In a preferred embodiment, the intermediate solid casing 150 comprises oilfield tubulars available from foreign and domestic steel mills.

The intermediate solid casing 150 is preferably coupled to one or more sections of the slotted casing 145. The intermediate solid casing 150 may be coupled to the slotted casing 145 using any number of conventional commercially available processes such as, for example, welding, or solid or slotted expandable connectors. In a preferred embodiment, the intermediate solid casing 150 is coupled to the slotted casing 145 by expandable solid connectors. The intermediate solid casing 150 may comprise a plurality of such intermediate solid casing 150.

In a preferred embodiment, each intermediate solid casing 150 includes one more valve members 170 for controlling the flow of fluids and other materials

within the interior region of the intermediate casing 150. In an alternative embodiment, as will be recognized by persons having ordinary skill in the art and the benefit of the present disclosure, during the production mode of operation, an internal tubular string with various arrangements of packers, perforated tubing, sliding sleeves, and valves may be employed within the apparatus to provide various options for commingling and isolating subterranean zones from each other while providing a fluid path to the surface.

In a particularly preferred embodiment, the intermediate casing 150 is placed into the wellbore 105 by expanding the intermediate casing 150 in the radial direction into intimate contact with the interior walls of the wellbore 105. The intermediate casing 150 may be expanded in the radial direction using any number of conventional commercially available methods.

In an alternative embodiment, one or more of the intermediate solid casings 150 may be omitted. In an alternative preferred embodiment, one or more of the slotted casings 145 are provided with one or more seals 140.

The shoe 155 provides a support member for the apparatus 130. In this manner, various production and exploration tools may be supported by the show 150. The shoe 150 may comprise any number of conventional commercially available shoes suitable for use in a wellbore such as, for example, cement filled shoe, or an aluminum or composite shoe. In a preferred embodiment, the shoe 150 comprises an aluminum shoe available from Halliburton. In a preferred embodiment, the shoe 155 is selected to provide sufficient strength in compression and tension to permit the use of high capacity production and exploration tools.

In a particularly preferred embodiment, the apparatus 130 includes a plurality of solid casings 135, a plurality of seals 140, a plurality of slotted casings 145, a plurality of intermediate solid casings 150, and a shoe 155. More generally, the apparatus 130 may comprise one or more solid casings 135, each with one or more valve members 160, n slotted casings 145, n-1 intermediate solid casings 150, each with one or more valve members 170, and a shoe 155.

During operation of the apparatus 130, oil and gas may be controllably produced from the targeted oil sand zone 125 using the slotted casings 145. The oil and gas may then be transported to a surface location using the solid casing

35. The use of intermediate solid casings 150 with valve members 170 permits isolated sections of the zone 125 to be selectively isolated for production. The seals 140 permit the zone 125 to be fluidicly isolated from the zone 120. The seals 140 further permits isolated sections of the zone 125 to be fluidicly isolated from each other. In this manner, the apparatus 130 permits unwanted and/or non-productive subterranean zones to be fluidicly isolated.

In an alternative embodiment, as will be recognized by persons having ordinary skill in the art and also having the benefit of the present disclosure, during the production mode of operation, an internal tubular string with various arrangements of packers, perforated tubing, sliding sleeves, and valves may be employed within the apparatus to provide various options for commingling and isolating subterranean zones from each other while providing a fluid path to the surface.

An apparatus has been described that includes one or more solid tubular members, one or more slotted tubular members, and a shoe. Each solid tubular member includes one or more external seals. The slotted tubular members are coupled to the solid tubular members. The shoe is coupled to one of the slotted tubular members. In a preferred embodiment, the apparatus further includes one or more intermediate solid tubular members coupled to and interleaved among the slotted tubular members. Each intermediate solid tubular member preferably includes one or more external seals. In a preferred embodiment, one or more of the solid tubular members include one or more valve members. In a preferred embodiment, one or more of the intermediate solid tubular members include one or more valve members.

An apparatus has been described that includes one or more primary solid tubulars, n slotted tubulars, n-1 intermediate solid tubulars, and a shoe. Each primary solid tubular includes one or more external annular seals. The slotted tubulars are coupled to the primary solid tubulars. The intermediate solid tubulars are coupled to and interleaved among the slotted tubulars. Each intermediate solid tubular includes one or more external annular seals. The shoe is coupled to one of the slotted tubulars.

A method of isolating a first subterranean zone from a second subterranean zone in a wellbore has been described that includes positioning one or more primary solid tubulars and one or more slotted tubulars within the wellbore. The primary solid tubulars traverse the first subterranean zone and the slotted tubulars traverse the second subterranean zone. The slotted tubulars and the solid tubulars are fluidicly coupled. The passage of fluids from the first subterranean zone to the second subterranean zone within the wellbore external to the solid and slotted tubulars is prevented.

A method of extracting materials from a producing subterranean zone in a wellbore, at least a portion of the wellbore including a casing, has been described that includes positioning one or more primary solid tubulars and one or more slotted tubulars within the wellbore. The primary solid tubulars are fluidicly coupled with the casing. The slotted tubulars traverse the producing subterranean zone. The producing subterranean zone is fluidicly isolated from at least one other subterranean zone within the wellbore. At least one of the slotted tubulars is fluidicly coupled with the producing subterranean zone. In a preferred embodiment, the method further includes controllably fluidicly decoupling at least one of the slotted tubulars from at least one other of the slotted tubulars.

Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

CLAIMS

1. A system for extracting fluidic materials from one or more subterranean formations traversed by a wellbore, comprising:

one or more solid tubular members positioned within the wellbore, one or more of the solid tubular members including one or more external seals;

one or more slotted tubular members positioned within the wellbore coupled to each of the solid tubular members for extracting fluidic materials from one or more of the subterranean formations; and

a shoe positioned within the wellbore coupled to one of the slotted tubular members;

wherein one or more of the solid tubular members are radially expanded into intimate contact with the wellbore.

2. The system of claim 1, further comprising;

one or more intermediate solid tubular members coupled to and interleaved among the slotted tubular members, one or more of the intermediate solid tubular members including one or more external seals.

3. The system of claim 1, further comprising one or more valve members for controlling the flow of fluidic materials through the solid tubular members.

4. The system of claim 2, wherein one or more of the intermediate solid tubular members include one or more valve members for controlling the flow of fluidic materials through the intermediate solid tubular

members.

5. A method of isolating a first subterranean zone from a second subterranean zone in a wellbore, comprising:

positioning one or more primary solid tubulars within the wellbore, each of the primary solid tubulars traversing the first subterranean zone;

positioning one or more slotted tubulars within the wellbore, each of the slotted tubulars traversing the second subterranean zone;

fluidicly coupling the slotted tubulars and the solid tubulars; and

preventing the passage of fluids from the first subterranean zone to the second subterranean zone within the wellbore external to the solid and slotted tubulars by radially expanding at least one of the primary solid tubulars into intimate contact with the wellbore.

6. A method of extracting materials from a producing subterranean zone in a wellbore, at least a portion of the wellbore including a casing, comprising;

positioning one or more primary solid tubulars within the wellbore;

fluidicly coupling the primary solid tubulars with the casing;

positioning one or more slotted tubulars within the wellbore, the slotted tubulars traversing the producing subterranean zone;

fluidicly coupling the slotted tubulars with the solid tubulars;

fluidicly isolating the producing subterranean zone from at least one other subterranean zone within the wellbore by radially expanding at least one of the solid tubulars into intimate contact with the wellbore; and

fluidicly coupling at least one of the slotted tubulars with the producing subterranean zone.

7. The method of claim 6, further comprising:

controllably fluidicly decoupling at least one of the slotted tubulars from at least one other of the slotted tubulars.

8. The system of claim 1, wherein the one or more slotted tubular members comprises a plurality of slotted tubular members coupled to the solid tubular members, each slotted tubular member comprising a tubular member defining a longitudinal passage and one or more radial passages fluidicly coupled to the longitudinal passage.

9. The method of claim 5, wherein positioning the one or more slotted tubulars comprises positioning a plurality of slotted tubulars within the wellbore, each slotted tubular comprising a tubular member defining a longitudinal passage and one or more radial passages fluidicly coupled to the longitudinal passage.

10. The method of claim 6, wherein positioning the one or more slotted tubulars comprises positioning a plurality of slotted tubulars within the wellbore, each slotted tubular comprising a tubular member defining a longitudinal passage and one or more radial passages

fluidicly coupled to the longitudinal passage.

11. An apparatus, comprising:

one or more solid tubular members positioned within a wellbore, each of the solid tubular members including one or more external seals;

one or more slotted tubular members positioned within the wellbore coupled to the solid tubular members; and

a shoe positioned within the wellbore coupled to one of the slotted tubular members;

wherein at least one of the solid tubular members and the slotted tubular members are formed by a radial expansion process performed within the wellbore in which at least one of the solid tubular members and the slotted tubular members are radially expanded into intimate contact with the wellbore.

12. The apparatus of claim 11, further comprising;

one or more intermediate solid tubular members positioned within the wellbore coupled to and interleaved among the slotted tubular members, each intermediate solid tubular member including one or more external seals;

wherein at least one of the solid tubular members, the slotted tubular members, and the intermediate solid tubular members are formed by a radial expansion process performed within the wellbore in which at least one of the solid tubular members, the slotted tubular members, and the intermediate solid tubular members are radially expanded into intimate contact with the wellbore.

13. The apparatus of claim 12, wherein one or more of the intermediate solid tubular members include one or more valve members for controlling the flow of fluids between the solid tubular members and the slotted tubular members.

14. The apparatus of claim 11, further comprising one or more valve members for controlling the flow of fluids between the solid tubular members and the slotted tubular members.

15. A system for extracting materials from a producing subterranean zone in a wellbore, at least a portion of the wellbore including a casing, comprising;

means for positioning one or more primary solid tubulars within the wellbore;

means for fluidicly coupling the primary solid tubulars with the casing;

means for positioning one or more slotted tubulars within the wellbore, the slotted tubulars traversing the producing subterranean zone;

means for fluidicly coupling the slotted tubulars with the solid tubulars;

means for fluidicly isolating the producing subterranean zone from at least one other subterranean zone within the wellbore;

means for fluidicly coupling at least one of the slotted tubulars with the producing subterranean zone; and

means for radially expanding at least one of the solid tubulars and the slotted tubulars into intimate contact with the wellbore.

16. The system of claim 15, further comprising: means for controllably fluidicly decoupling at least one of the slotted tubulars from at least one other of the slotted tubulars.

17. The system of claim 15, further comprising means for positioning a plurality of slotted tubulars within the wellbore; wherein each slotted tubular consists of:

a tubular member defining a longitudinal passage and one or more radial passages fluidicly coupled to the longitudinal passage.